

REMARKS/ARGUMENTS

This Amendment is submitted in response to the Office Action dated March 29, 2006, and within the period for response extending to July 31, 2006, with a one-month extension of time. Please note that July 29, 2006, is a Saturday. Therefore, the period for response with a one-month extension of time extends to Monday, July 31, 2006.

Claim 3 is cancelled.

Claims 1, 4-6, 11-13, 18-20, and 23-24 are amended.

Claims 1-2 and 4-24 are pending.

Rejections under 35 U.S.C. 112

Claims 1-24 were rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. These rejections are traversed.

The Office has asserted that the phrase "the etching of the conductive layer being configured to trigger an end point just before all of the conductive material is removed from over the dielectric layer" renders each of claims 1 and 11 indefinite because it is unclear how the endpoint is detected just before removing all of the conductive material. Similarly, the Office has asserted that the phrase "the etching of the polysilicon material being configured to trigger an endpoint just before all of the polysilicon material is removed from over the silicon dioxide layer" renders claim 18 indefinite because it is unclear how the endpoint is detected just before removing all of the polysilicon material.

Each of claims 1 and 11 have been amended to recite the following:

"e1) planarization etching the conductive material to substantially planarize the conductive material;

- e2) utilizing interferometric endpoint detection to identify an endpoint of the planarization etching, the endpoint of the planarization etching occurring just before all of the conductive material is removed from over the dielectric layer that overlies the hard mask;
- e3) stopping the planarization etching upon identification of the endpoint of the planarization etching."

Claim 18 has been amended to recite the following:

- "e1) planarization etching the polysilicon material to substantially planarize the polysilicon material, the planarization etching of the polysilicon material using a first chemistry including Cl₂, He, and SF₆;
- e2) utilizing interferometric endpoint detection to identify an endpoint of the planarization etching, the endpoint of the planarization etching occurring just before all of the polysilicon material is removed from over the silicon dioxide layer that overlies the hard mask;
- e3) stopping the planarization etching upon identification of the endpoint of the planarization etching."

Amended claims 1, 11, and 18 recite that the endpoint of the planarization etching is detected by utilizing interferometric endpoint detection. Amended claims 1 and 11 also recite that the endpoint of the planarization etching is identified as occurring just before all of the conductive material is removed from over the dielectric layer. Further, amended claim 18 recites that the endpoint of the planarization etching is identified as occurring just before all of the polysilicon material is removed from over the silicon dioxide layer.

In view of the foregoing, the Applicants respectfully submit that each of independent claims 1, 11, and 18, and their corresponding dependent claims, particularly point out and distinctly claim the subject matter which the Applicants regard as the

invention, in accordance with the requirements of 35 U.S.C. 112, second paragraph. Therefore, the Office is kindly requested to withdraw the rejections of claims 1-2 and 4-24 under 35 U.S.C. 112.

Rejections under 35 U.S.C. 102

Claim 1 was rejected under 35 U.S.C. 102(e) as being anticipated by Lill et al. ("Lill" hereafter) (U.S. Patent No. 6,284,665). This rejection is traversed.

Prior to the planarization etching operation, claim 1 recites that a hard mask is formed over a substrate and a trench is etched in the substrate using the hard mask. Then, claim 1 recites that a dielectric layer is formed over the hard mask and in the trench, such that the dielectric layer is configured to line the trench. Then, claim 1 recites that a conductive material is applied over the dielectric layer such that a blanket of the conductive material overlies the hard mask and fills the trench.

Amended claim 1 then recites that a planarization etching operation is performed to substantially planarize the conductive material. Amended claim 1 also recites that interferometric endpoint detection is used to identify an endpoint of the planarization etching. Moreover, amended claim 1 recites that the endpoint of the planarization etching occurs just before all of the conductive material is removed from over the dielectric layer that overlies the hard mask. It should be understood that the hard mask is formed over the substrate. Therefore, it should also be understood that the dielectric layer that overlies the hard mask corresponds to the portion of the dielectric layer that is formed over the hard mask and over the substrate, i.e., the portion of the dielectric layer that is not formed in the trench.

Amended claim 1 further recites that the planarization etching operation is stopped upon identification of the endpoint of the planarization etching. Thus, the planarization etching is stopped just before all of the conductive material is removed from

over the dielectric layer that overlies the hard mask. Therefore, upon stopping the planarization etching, a small amount of planarized conductive material will be left on top of the dielectric layer. Furthermore, upon stopping the planarization etching, the dielectric layer both over the hard mask and within the trench will remain intact, i.e., will not have been removed to any extent by the planarization etching operation.

Claim 1 further recites that a recess etching operation is performed following the planarization etching operation. The recess etching serves to remove the conductive material left on top of the dielectric layer above the hard mask at the end of the planarization etching. The recess etching also serves to remove part of the conductive material from within the trench. Claim 1 further clarifies that the recess etching operation is performed using a different chemistry than that used to perform the planarization etching.

Lill teaches formation of a hard mask, i.e., silicon nitride barrier layer 8, over a substrate 2 and formation of a trench in the substrate using the hard mask. Lill also teaches formation of a dielectric film 10 over the hard mask and in the trench, such that the dielectric film is configured to line the trench. Figure 4 of Lill shows the trench configuration of Lill at this point. Lill further teaches that a conductive material, i.e., polysilicon 12, is applied over the dielectric film 10 such that a blanket of the conductive material overlies the hard mask and fills the trench. Figure 5 of Lill shows the trench configuration of Lill at this point.

Continuing from the configuration shown in Figure 5 of Lill, the teachings of Lill differ from the method of claim 1. Specifically, Lill (12:18-41) teaches that both the dielectric film 10 and the polysilicon 12 are etched back to a predetermined depth B within the trench. This etching of both the dielectric film 10 and the polysilicon 12 by Lill occurs in lieu of the planarization etching operation of claim 1.

It should be understood that the etching of both the dielectric film 10 and the polysilicon 12 by Lill cannot be reasonably interpreted as teaching the planarization etching operation as recited in claim 1. Specifically, claim 1 requires that the planarization etching operation be stopped just before all of the conductive material is removed from over the dielectric layer that overlies the hard mask. However, Lill teaches that both the polysilicon 12 and the dielectric film 10 are etched to a predetermined depth B within the trench. Thus, Lill teaches that all of the polysilicon 12 and dielectric film 10 are removed from over the hard mask before their etching is stopped at the predetermined depth B within the trench. Figure 6b of Lill shows the trench configuration of Lill following etching of both the polysilicon 12 and dielectric film 10 to the predetermined depth B within the trench.

Additionally, because claim 1 recites that the recess etching operation is performed using a different chemistry than the planarization etching operation, it is not appropriate to interpret the etching of both the polysilicon 12 and dielectric film 10 (which is performed using a single chemistry) as representing a combination of the planarization etching and recess etching operations recited in claim 1. Furthermore, claim 1 recites that interferometric endpoint detection is used to identify the endpoint of the planarization etching operation that occurs just before all of the conductive material is removed from over the dielectric layer that overlies the hard mask. Notwithstanding the fact that Lill does not teach the planarization etching process, as discussed above, Lill also does not teach the use of interferometric endpoint detection to identify the endpoint of a planarization etching process.

As the Office is aware, for a claim to be anticipated under 35 U.S.C. 102, each and every feature of the claim must be taught by a single prior art reference. As discussed above, Lill fails to teach a number of the features recited in amended claim 1. Therefore, the Applicants respectfully submit that amended claim 1 is not anticipated by Lill. The

Office is kindly requested to withdraw the rejection of amended claim 1 under 35 U.S.C. 102.

Rejections under 35 U.S.C. 103

Claims 2-7 and 10-15 were rejected under 35 U.S.C. 103(a) as being unpatentable over Lill in view of Pau et al. ("Pau" hereafter) (U.S. Patent No. 6,635,573). These rejections are traversed.

With regard to independent claim 11, the Office has relied upon Lill to teach the method operations other than the use of interferometric endpoint detection to identify the endpoint of a planarization etching process. The Office has referenced Pau as teaching the use of interferometry monitoring. The Office has asserted that it would have been obvious to one skilled in the art at the time of the invention to have combined the teachings of Lill and Pau to arrive at the invention as recited in claim 11.

The Applicants submit that the combination of Lill and Pau fails to teach or suggest each and every feature of claim 11. More specifically, the Office relies upon Lill to teach the planarization etching operation of claim 11. However, in contrast to Lill's teachings, as previously discussed with respect to the rejection of claim 1 under 35 U.S.C. 102, claim 11 requires that the planarization etching operation be stopped just before all of the conductive material is removed from over the dielectric layer that overlies the hard mask. It should be noted that Pau is silent with regard to the planarization etching operation as recited in claim 11.

Furthermore, because the combination of Lill and Pau fails to teach the planarization etching operation of amended claim 11, it follows that the combination of Lill and Pau cannot be reasonably construed to teach an operation associated with the planarization etching operation. Specifically, although Pau teaches interferometry monitoring in a particular context, because the planarization etching operation of

amended claim 11 is not taught by either Lill or Pau, use of Pau's interferometry monitoring to identify an endpoint of the planarization etching operation, as recited in amended claim 11, can only be derived through hindsight afforded by the disclosure of the present invention.

As the Office is aware, a claim is rendered prima facie obvious under 35 U.S.C. 103 only when the combined prior art teaches each and every feature of the claim. For at least the reasons discussed above, the Applicants submit that the combination of Lill and Pau fails to teach each and every feature of amended claim 11. Therefore, the Applicants submit that amended claim 11 is patentable over Lill in view of Pau. The Office is kindly requested to withdraw the rejection of claim 11.

Because a dependent claim incorporates all features of its independent claim, the Applicants submit that each of the dependent claims 2, 4-7, 10, and 12-15 is patentable for at least the same reasons provided for its respective independent claim. Therefore, the Office is kindly requested to withdraw the rejections of dependent claims 2, 4-7, 10, and 12-15. The Office is requested to note that claim 3 is cancelled.

Claims 8-9, 16, and 18-24 were rejected under 35 U.S.C. 103(a) as being unpatentable over Lill in view of Pau as applied to claims 2-7 and 10-15, and further in view of Yang et al. ("Yang" hereafter) (U.S. Patent No. 5,436,190). These rejections are traversed.

With regard to independent claim 18, the Office has relied upon Lill to teach the method operations other than the use of interferometry monitoring to identify the endpoint of a planarization etching process and the use of an Ar and SF₆ chemistry to perform the recess etching operation. The Office has referenced Pau as teaching the use of interferometry monitoring. The Office has referenced Yang as teaching the use of an Ar and SF₆ chemistry to perform an etching operation. The Office has asserted that it would

have been obvious to one skilled in the art at the time of the invention to have combined the teachings of Lill, Pau, and Yang to arrive at the invention as recited in claim 18.

The Applicants submit that the combination of Lill, Pau, and Yang fails to teach or suggest each and every feature of claim 18. More specifically, the Office relies upon Lill to teach the planarization etching operation of claim 18. However, in contrast to Lill's teachings, as previously discussed with respect to the rejection of claim 1 under 35 U.S.C. 102, claim 18 requires that the planarization etching operation be stopped just before all of the conductive material is removed from over the dielectric layer that overlies the hard mask. It should be noted that both Pau and Yang are silent with regard to the planarization etching operation as recited in claim 18.

Furthermore, because the combination of Lill, Pau, and Yang fails to teach the planarization etching operation of amended claim 18, it follows that the combination of Lill, Pau, and Yang cannot be reasonably construed to teach an operation associated with the planarization etching operation. Specifically, although Pau teaches interferometry monitoring in a particular context, because the planarization etching operation of amended claim 18 is not taught by either Lill, Pau, or Yang, use of Pau's interferometry monitoring to identify an endpoint of the planarization etching operation, as recited in amended claim 18, can only be derived through hindsight afforded by the disclosure of the present invention.

Again, a claim is rendered *prima facie* obvious under 35 U.S.C. 103 only when the combined prior art teaches each and every feature of the claim. For at least the reasons discussed above, the Applicants submit that the combination of Lill, Pau, and Yang fails to teach each and every feature of amended claim 18. Therefore, the Applicants submit that amended claim 18 is patentable over the combination of Lill, Pau, and Yang. The Office is kindly requested to withdraw the rejection of claim 18.

Because a dependent claim incorporates all features of its independent claim, the Applicants submit that each of the dependent claims 8-9, 16, and 19-24 is patentable for at least the same reasons provided for its respective independent claim. Therefore, the Office is kindly requested to withdraw the rejections of dependent claims 8-9, 16, and 19-24.

The Applicants respectfully submit that all of the pending claims are in condition for allowance. Therefore, a Notice of Allowance is requested. If the Examiner has any questions concerning the present Amendment, the Examiner is kindly requested to contact the undersigned at (408) 774-6914. Also, if any additional fees are due in connection with filing this Amendment, the Commissioner is authorized to charge Deposit Account No. 50-0805 (Order No. LAM2P298). A duplicate copy of the transmittal is enclosed for this purpose.

Respectfully submitted,
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